ATTORNEY DOCKET NO.: STNL 2656002 PATENT APPLICATION

EXPRESS MAIL LABEL NO.: EV 284898872 US DATE OF DEPOSIT: 2/20/04

I hereby certify that this paper and/or fee are being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 CFR §1.10 on the date indicated above and is addressed to: Mail Stop: Patent Applications, Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450.

Bradley D. Ellis

Name: Bradley D. Ellis

METHOD AND APPARATUS FOR CUSTOM MANUFACTURING OF DECORATIVE, CAST STONEWORK

Inventor: Richard Carey
3005 Woodside Street
Dallas, Texas 75204

Carr LLP
670 Founders Square
900 Jackson Street
Dallas, Texas 75202

ATTORNEY DOCKET NO.
STNL 2656002

PATENT APPLICATION

METHOD AND APPARATUS FOR

CUSTOM OF MANUFACTURING OF DECORATIVE, CAST STONEWORK

CLAIM OF PRIORITY

This application claims priority from U.S. Provisional Patent Application No. 60/449,493 entitled "METHOD AND APPARATUS FOR STONEWORK CONSTRUCTION" by Carey, on February 21, 2003 (Attorney Docket No. STNL 2656000), and is related to U.S. Patent Application Ser. No. ____, Attorney Docket No. STNL 2656001, entitled "METHOD AND APPARATUS FOR PARAMETRIC DESIGN OF CUSTOM DECORATIVE STONEWORK," filed on even date herewith, and to U.S. Patent Application Ser. No. ____, Attorney Docket No. STNL 2656003, entitled "METHOD AND APPARATUS FOR INTERACTIVELY DESIGNING CUSTOM DECORATIVE STONEWORK," filed on even date herewith, the contents of which are hereby incorporated by reference.

FIELD OF THE INVENTION

The present invention relates generally to automated manufacturing of stonework and, more particularly, to custom production of decorative stonework.

DESCRIPTION OF THE RELATED ART

In the construction industry, decorative stonework has been common feature for a number of years. Larger and larger portions of stone are used in the construction of buildings and houses. Decorative stonework can be made by being cut from natural stone, cut from man-made materials, cast from molds, extruded or any combination of these techniques. Of these techniques, one of the most economical is casting using molds. Generally speaking, casting the stonework allows the aesthetics associated with decorative stonework to be preserved while reducing the overall cost.

The process of manufacturing cast decorative stonework typically involves pouring a limestone-based material into a mold and allowing it to harden. Once the material has hardened it is removed from the mold as a manufactured decorative stonework piece.

In some instances, a product may be formed of a single piece. However, more typically, more complex products, such as door frames, are not molded out of one continuous piece of manufactured stone. Instead, several pieces are assembled, usually at the job site, to yield the structure. The molds, then, are usually for the smaller components of the large

whole product.

Architecture is a high art form that has been around since earliest days. The Romans and Greeks were master architects. These groups adopted certain stylistic features that were associated with their architecture. In the traditional organizational scheme, architectural features are each given certain titles. For example, Doric, Ionic, and Corinthian columns are examples of Greco-Roman architectural features. Doric columns are least ornate of the three, having a plain shaft and a simple cap. Ionic columns are more ornate, having flutes caved into the shaft and a more ornate cap, such as scrolls. The Corinthian columns are the most ornate, usually with an extremely ornate cap. However, even through these architectural features accurately describe the features of a structure, the average layperson may not be able to describe a Doric column, let alone know the name of the feature.

The customer is often a layperson and at the start of a project may not even know specifically what feature he or she desires. In fact, most laypersons would typically have only a holistic knowledge or a feel for what he or she wants. Traditional organizational schemes, though, may not necessarily provide a logical correlation to the average layperson.

To alleviate the problem associated with logical associations, it would be desirable to have a database organizational scheme can be employed to better assist a lay customer or a professional in choosing the decorative stonework associated with desired architectural features.

Several problems exist with the design, manufacture, and assembly of manufactured decorative stonework. For a given manufacturer of stone work, the molds can number in the tens of thousands. Changing the proportions of a given architectural feature can be cumbersome. There can be physical limitation as well as aesthetic considerations. Also, by changing the proportions of a given feature, the molds utilized to make the parts that compose the given architectural feature may have to be changed. Compounding the complexity of this problem is the fact that most decorative stonework products are custom designed to fit individual customer's tastes at the time a structure is designed. The decorative stonework products must also meet size and structural requirements dictated by other, non-stonework products (such as a wooden entry door) or natural geographic features of the site. Thus, oftentimes, no two decorative stonework products will be exactly alike.

The parameters required for designing decorative stonework

may not be known until the time a design for the entire structure is substantially complete. Nevertheless, decorative stonework must usually be incorporated into the design of a structure at the concept stage or it may be impractical to add later. Thus, the ability to design decorative stonework products at a very early stage of the conceptualization of a structure extremely quickly, from sometimes incomplete parameters, at least to the point that the appearance of the decorative stonework products in conjunction with the structure can be determined and the cost reliably estimated can be the difference between the structure ultimately including or not including any decorative stonework.

Decorative stonework is typically very heavy. It can also be prone to damage during transportation if not properly packaged or unnecessarily handled. Typically, it will not be possible to pre-assemble the components at the stonework manufacturer's facility to ensure proper fit. To maintain an economical product, it is necessary to design and manufacture the components for the custom decorative stonework product, which may be one-of-a-kind, from tens of thousands of parts and their molds in an almost unlimited number of sizes, configurations and styles to fit with an unlimited number of structural designs. Then, all the components and their

supporting documentation must be transported to the job site in all the correct sizes and at the right time.

Therefore, there is a need for a method and/or apparatus for facilitating and at least partially automating the process of selection, identification, design and manufacturing of custom decorative stonework products that at least addresses some of the problems associated with conventional methods and apparatuses.

SUMMARY OF THE INVENTION

The present invention provides a method for custom manufacturing decorative, cast stonework that comprises receiving an order, wherein the order at least comprises one drawing, and wherein the at least one drawing at least comprises at least one part of a plurality of parts that comprise a unit. The method also includes storing the order and referencing the at least one first part to a database of units and parts, wherein the least one first part number is associated with the at least one first part. The method further comprises determining if a suitable unused part of a plurality of unused parts exists within an inventory of unused parts by an associated part identifier, wherein each unused part of the plurality unused parts have part identifiers

associated therewith. The method then checks to determine if no suitable part exists in the inventory of unused parts, and if no part exists, further comprises determining if a mold for the at least one part exists in an inventory of molds. The method then checks to determine if a mold exists in the inventory of molds. Then, if no mold exists, the method further comprises manufacturing or buying a mold for the at least one first part. If a mold exists in the inventory of molds, the method then determines if the mold is available. If the mold is available, the method retrieves the mold and casts the at least one first part with the mold that has been retrieved.

BRIEF DESCRIPTION OF THE DRAWINGS

For a more complete understanding of the present invention and the advantages thereof, reference is now made to the following descriptions taken in conjunction with the accompanying drawings, in which:

FIGURE 1 is a block diagram depicting an improved organizational structure;

FIGURE 2 is a block diagram depicting a circle top doorway;

FIGURE 3 is a first example of a profile;

FIGURE 4 is a second example of a profile;

FIGURES 5a-5d are examples of units;

FIGURE 6 is a block diagram depicting the system for custom molding decorative, cast stonework; and

FIGURES 7a and 7b are flow charts depicting the process of molding custom, decorative stonework.

DETAILED DESCRIPTION

In the following discussion, numerous specific details are set forth to provide a thorough understanding of the present invention. However, those skilled in the art will appreciate that the present invention may be practiced without such specific details. In other instances, well-known elements have been illustrated in schematic or block diagram form in order not to obscure the present invention in unnecessary detail.

Referring to FIGURE 1 of the drawings, the reference numeral 100 generally designates an improved organizational structure. The improved organizational structure 100 comprises a unit description 102, part descriptions 104, and profile descriptions 106.

When either a professional or a customer begins the process of choosing stonework, typically there is a first

association to a specific item, such as a window. This first association is designated as a unit 102. The unit 102 can be either a very simple or a complex item ranging from a simple feature, such as a window frame, to more complex features, such as gazebos and staircases.

As it is well known, decorative stonework products are often not composed of a single, continuously molded block. Instead, to maximize the ability to create numerous varieties of units 102 while attempting to minimize costs, individual components or parts 104 are utilized. These parts are sometimes interchangeable and, thus, are capable of being used for a number of units. Furthermore, the parts 104 can be increased in size to create a large individual unit. Therefore, in the improved organizational scheme 100, each unit 102 is subdivided into numerous parts 104. Some parts, however, are not properly interchangeable with other parts either for physical or for aesthetic reasons.

To increase the appeal of each of the units 100 and to include as many architectural styles as is possible, each part 104 has an associated profile 106. The profile 106 is typically a vertical or horizontal cross-sectional view of a given part 104. The shapes associated with crown molding are one example of such a profile feature. With crown molding, a

piece of wood or stonework is shaped to have curves or shapes on the surface. A cross-sectional view of the crown molding would be a profile. Also, profiles can also be overall views if the surface contains more intricate molded carvings, such as carved leaves.

By creating the associative database, a lay customer or professional is more capable of choosing desired features in stonework. Instead of sorting through either pictures of buildings or of sets of architectural features, a customer or professional can look through components or units 102 of a design scheme. By allowing a customer, specifically, to sort through the varieties of stonework available by unit 102, the attention of the customer will more likely be retained. Preservation of a customer's attention clearly can preserve a possible sale that would provide a benefit to the customer and to the manufacturer/retailer.

Referring to FIGURE 2 of the drawings, the reference numeral 200 generally designates an example of a unit. The unit comprises a first part 202, a second part 204, a third part 206, a fourth part 208, a fifth part 210, a sixth part 212, a seventh part 214, and an eighth part 216.

The unit 200 is an example of a stone circle top door frame. The door frame of the unit 200 is not composed of a

single, continuous piece of manufactured stone. Instead, the door frame of the unit 200 is composed of eight distinct parts 202, 204, 206, 208, 210, 212, 214, and 216. Each of the eight parts 202, 204, 206, 208, 210, 212, 214, and 216 can vary in size depending on the dimensions of the door frame itself.

Moreover, the style of the door frame of the unit 200 can be changed by interchanging some parts. For example, if a customer chooses to have an eyebrow door frame instead of a circular door frame, as shown in FIGURE 2, then most of the original parts can be retained. The difference between an eyebrow door frame and a circular door frame is the arc across the top of the frame. The top of the circular door frame has a radius equal to one half the distance between the sides of the doorframe, whereas the top of an eyebrow doorframe is larger than the one half the distance between the sides of the doorframe. Therefore, it is possible to retain the third part 206, the fourth part 208, the fifth part 210, the sixth part 212, the seventh part 214, and the eighth part 216. Hence, the first part 202 and the second part 204 can be replaced with parts that possess a larger arc.

Providing the customer with an association as expressed can therefore lead to easier choosing of design elements. If circular door frames and eyebrow door frames are associated

with different architectural styles, a customer may holistically know that he or she prefers an eyebrow door frame. However, if the customer has a particular affinity for an architectural style that does not incorporate eyebrow door frames, then a customer can become frustrated because he or she does not know the name of the particular style of door frame or the specific architectural style to which the door frame belongs. Hence, organization of stonework into units, such as the door frame of unit 200, can assist the customer.

FIGURES 3 and 4 are examples of profiles. Both the first profile 300 and the second profile 400 are horizontal cross-sections of a given part. The dimensions of each profile 300 and 400 are typically measured by three dimensions. The height Y, the upper depth X and the lower depth Z are related to the overall size of the given part 104. There are profiles that can be utilized in order to provide varying degrees of aesthetic flair.

FIGURES 5a-5d are examples of units. FIG. 5a depicts an unfluted Corinthian column, and FIG. 5c depicts an unfluted Doric column. Specifically, the picture of FIGS. 5a and 5c only depict the caps of each of the respective columns because the caps are what differentiate the Corinthian column from the Doric column.

FIGURES 5b and 5d, on the other hand, depict more complex units. Specifically, each of the respective pictures depicts an entryway. FIG. 5b is denoted as a "Castile Aragon II" that is a style of architecture common to the Aragon region of Northeast Spain. FIG. 5d is denoted as "Boxwood Manor" that is a style of architecture more indicative of the Southwest United States.

Referring to FIGURE 6 of the drawings, the reference numeral 600 generally designates a block diagram depicting the system for custom molding decorative, cast stonework. The system 600 comprises a computer network 602, a server 604, a computer infrastructure 606, a database of mold locations/uses 608, an inventory database 610, a warehouse of molds 614, an inventory 616, a manufacturing facility 618, and an order database 638.

The process of molding custom, decorative stonework is a difficult task to accomplish. Firstly, the stone utilized in the decorative stonework is heavy, typically on the order of several hundred or more pounds. The stone is also cumbersome due to the shape and weight. Therefore, it is not economically feasible to store vast amounts of stone.

To alleviate the problems associated with storing vast numbers of stone, the decorative stonework is, instead,

manufactured after an order is placed and immediately before delivery. However, the molds, too, can be quite large and cumbersome. In fact, large warehouses are typically utilized to store thousands or tens of thousands of molds. As a result, maintaining a proper accounting of the location and usage of scarp materials and molds becomes increasely important.

In order to provide a more rapid and efficient method to mold stonework, computer tracking system 600 is employed. The tracking system 600 is overlaid on the database 100 of FIGURE 1. That way, for each unit designed, which corresponds to an architectural feature, the respective parts comprising the unit are easily determined.

The system 600 operates receiving multiple transmissions of operable data. The server 604 for the system 600 is coupled to the computer network 602 through a first communication channel 620. The computer network 602 can be a variety of computer networks including, but not limited to, the Internet. The server 622 is then coupled to the computer infrastructure 606 through a second communication channel 622. Through the computer network 602 and the server 620, drawings or designs can be transmitted. The computer infrastructure 606 stores the drawings or designs transmitted by a client on

the order database 638. The drawings are communicated to the order database 638 from the computer infrastructure 606 through a third communication channel 640.

Once the drawing or design has been stored in the order database 638, the computer infrastructure 606 can then process the drawings or designs. However, to complete the orders in the most economical fashion, an inventory of unused stone is maintained along with a plurality of molds. The inventory database 610 is utilized to maintain a proper accounting of the inventoried stone that is previously unused, and the database of mold locations/uses 608 maintains a proper accounting of mold locations in the warehouses and if the molds are in use for another order. The computer infrastructure 606 maintains the inventory database 610 as well as the database of mold locations/uses 608. The computer infrastructure 606 transmits data to and receives data from the inventory database 610 and the database of mold locations/uses 608 through a fourth communication channel 636 and a fifth communication channel 626, respectively.

The system of manufacturing may not be entirely automated, though. An employee can gain access to the order to fulfill the order. Typically, an employee will assist in transmitting usage of molds and inventoried stone to the

computer infrastructure 606. However, it is possible to have an entirely automated process. An employee can gain access to information stored on the computer infrastructure 606 though the workstation 612. The workstation 612 sends and receives information from the computer infrastructure 606 through a sixth communication channel 632. Updates regarding the inventory 616 are transmitted to the computer infrastructure 606 through a seventh communication channel 634. Updates regarding the mold locations in the warehouse 614 and mold usage in the manufacturing facility 618 are transmitted through an eighth communication channel 630 and a ninth communication channel 624, respectively.

Referring to FIGURES 7a and 7b of the drawings, the reference numeral 700 generally designates a flow chart depicting the process of molding custom, decorative stonework.

The process of molding the parts of a unit is a relatively complex process that can be accomplished electronically. In step 702, a CAD drawing, complete with part numbers or other identifiers, is received. The reception of the CAD drawing of step 710 is accomplished through the usage of the computer network 602 of FIGURE 6. Included in step 702, the computer infrastructure 606 of FIG. 6 stores the order in the order database 638 of FIG. 6.

Associated with each drawing is a timeframe in which the order is to be completed. The computer infrastructure 606 of FIGURE 6 will almost continually determine whether the time is proper to cast the stonework in step 704. If the timing is not correct, then the computer infrastructure 606 of FIG. 6 waits in step 706. The reason for waiting for the correct timing is that the timing for the casting of the stonework is important. The stonework, typically, is cast just prior to shipping because it is not convenient or economically feasible to cast the stonework for too far in advance. The stonework is oftentimes large, cumbersome, and heavy, making storage difficult. Moreover, the possibility often exists that an order may be cancelled.

Once the timing for the creation of the stonework has come, each part comprising a unit has to be cast or brought out of inventory. Prior to casting a new stone part, the computer infrastructure 606 of FIGURE 6 makes a determination as to whether there is a part in inventory that may suffice in step 708. If there may be a suitable piece of unused stone, another determination is made as to whether the stone is the correct size in step 710. In step 712, if the unused stone is not the correct size a determination is made as to whether the stone can be cut to the proper size. The stone is then cut to

size in step 714. Once a stone of the correct size is brought out of inventory, then the stone is ready to be shipped in step 716. Then in step 718, a determination is made if the order has been complete.

Once a determination has been made that a suitable part is not in inventory 616 of FIGURE 6, the molding process is employed. The computer infrastructure 606 of FIG. 6 determines whether a mold for the part exists in step 720. If the mold does not exist, then the mold is manufactured in step 721. However, if the mold does exist, a problem can arise if the mold is in use. Therefore, the computer infrastructure 606 of FIG. 6 determines if the mold is in use in step 722, and waits for the mold to become available in step 724.

Once a mold has become available, then the part is cast. In steps 726 and 728, the computer infrastructure 606 of FIGURE 6 locates and retrieves the mold. The mold is then poured and allowed to harden in steps 730 and 732. Once hardened, the mold is returned and the part is ready to ship in step 734. A determination is then made as to the status of completion in step 736. If the order is complete, then the process begins again for another part in step 708. An example of an embodiment of the invention is further described in

Appendices A to M, the contents of which are hereby incorporated by reference.

By providing a sophisticated automation system to custom manufacture stonework, the economic benefits are substantial. The systems and software allow a manufacturer to use CAD or other drawing types to easily cast custom stonework while maintaining a proper accounting of all inventoried, unused stone and of the vast numbers of molds required to manufacture cast stonework. By reducing the number of personnel required to manufacture the cast stonework, overhead costs are substantially reduced. Therefore, the competitive edge in the cast stonework industry would tilt toward a manufacturer that has reduced overhead as a result of increased automation.

It is understood that the present invention can take many forms and embodiments. Accordingly, several variations may be made in the foregoing without departing from the spirit or the scope of the invention. The capabilities outlined herein allow for the possibility of a variety of programming models. This disclosure should not be read as preferring any particular programming model, but is instead directed to the underlying mechanisms on which these programming models can be built.

Having thus described the present invention by reference to certain of its preferred embodiments, it is noted that the embodiments disclosed are illustrative rather than limiting in nature and that a wide range of variations, modifications, changes, and substitutions are contemplated in the foregoing disclosure and, in some instances, some features of the present invention may be employed without a corresponding use of the other features. Many such variations and modifications may be considered desirable by those skilled in the art based upon a review of the foregoing description of preferred embodiments. Accordingly, it is appropriate that the appended claims be construed broadly and in a manner consistent with the scope of the invention.